Certification Test Report

FCC ID: X32-MTHKG000
IC: 8797A-MTHKG000

FCC Rule Part: 15.231
ISED Canada Radio Standards Specification: RSS-210

TÜV SÜD Report Number: RD72133624.102

Manufacturer: iKeyless, LLC
Model: MTHKL-G000

Test Begin Date: February 19, 2018
Test End Date: March 08, 2018

Report Issue Date: June 05, 2018

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code AT-1921

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

Prepared by:

Jean Tezil
EMC Engineer
TÜV SÜD America, Inc.

Reviewed by:

Randle Sherian
EMC Manager
TÜV SÜD America, Inc.

2320 Presidential Drive, Suite 101, Durham, NC 27703 USA Voice: 919-381-4235 Fax: 770-831-8598

TABLE OF CONTENTS

1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Innovation, Science, and Economic Development Canada's Radio Standards Specification RSS-210.

1.2 Product description

Remote product MTHKL-G0XX is an aftermarket replacement keyless entry remote for automobiles. The remote is designed such that it can emulate the functionality of a wide range of existing OEM remotes operating at 313.85 MHz or 315 MHz with FSK modulation. The emulated remote is configured from a predetermined list of car remotes by the user. The remote features a microcontroller/transmitter, 4 buttons, and a user LED. The remote electronics are contained inside an ABS plastic shell. The device is powered by a single CR1620 coin cell battery. The current report covers both frequencies of operation.

Technical Information:
Operating Frequency: 313.85 MHz (Mode 1)
Operating Frequency: 315 MHz (Mode 2)
Mode 1: FSK +/- 40 kHz, PWM encoding
Mode 2: FSK +/- 40 kHz, Manchester Encoding
Operating Voltage: 3 VDC (Battery)
Antenna Type / Gain: PCB Loop / -15.0 dBi

Manufacturer Information:
iKeyless, LLC
828 E Market St
Louisville, KY 40206

Test Sample Serial Number(s): TUV 1/TUV 3 for Radiated Measurements and TUV 2/ TUV 4 for Duty Cycle and Bandwidth Measurements

Test Sample Condition: The test sample was provided in working order with no visible defects.

1.3 Test Methodology and Considerations

The EUT is a stand-alone handheld device and was tested in (3) orientations which represent normal intended operation.

The EUT is a battery powered device. Therefore, AC power line conducted emissions was not performed.

Multiple samples were preconfigured by the client for specific tests with instructions to turn on/off the transmitter in the desired mode.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

TÜV SÜD America Inc.
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 381-4235

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America Inc. is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1921 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

FCC Registered Test Site Number: 637011
ISED Canada Test Site Registration Number: 20446

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 18' x 28' x 18' shielded enclosure. The chamber is lined with Samwha Electronics Co. LTD Ferrite Absorber, model number SFA300 (HSN-1). The ferrite tile is 10cm x 10 cm and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. On top of the ferrite tiles is DMAS HT-45 (Dutch Microwave Absorber Solutions) hybrid absorber on all walls except the wall behind the antenna mast which has a shorter DMAS HT-25 absorber.

The turntable is 1.50m in diameter and is located 150cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using short #6 copper wire. The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the turntable. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane.

Behind the turntable is a 2' x 6' x 1.5' deep shielded pit used for support equipment if necessary. The pit is equipped with 2 - 4" PVC chase from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

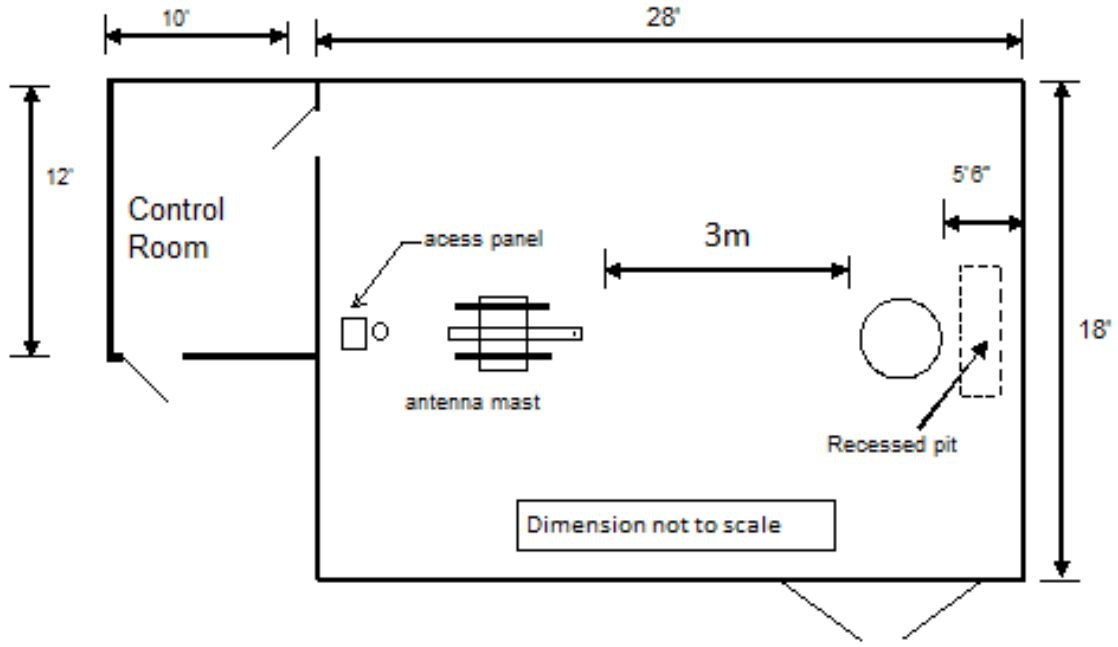

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 10' sheet galvanized steel horizontal ground reference plane (GRP) bonded every 6" to an 8' X 8' aluminum vertical ground plane.

A diagram of the room is shown below in figure 2.4-1:

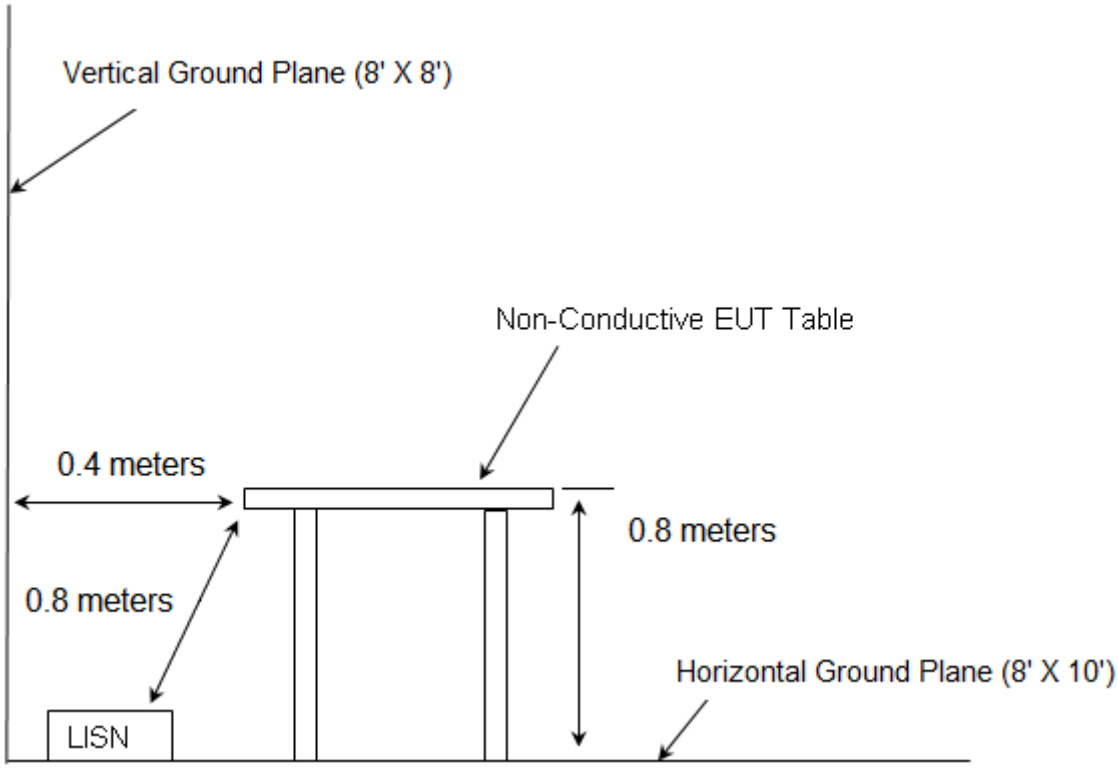

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2017
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2017
- ISED Canada Radio Standards Specification: RSS-210 – Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment, Issue 9, November 2017
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, Nov 2014.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Asset ID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
DEMC0277	EMCO	93146	Antennas	9904-5199	9/12/2016	9/12/2018
DEMC0626	EMCO	3110B	Antennas	9411-1945	3/21/2017	3/21/2019
DEMC3002	Rohde & Schwarz	ESU40	Receiver	100346	7/24/2017	7/24/2018
DEMC3006	Rohde & Schwarz	TS-PR18	Amplifiers	122006	1/10/2018	1/10/2019
DEMC3012	Rohde & Schwarz	EMC32-EB	Software	100731	NCR	NCR
DEMC3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	2/7/2018	2/7/2020
DEMC3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	1/5/2018	1/5/2019
DEMC3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	1/5/2018	1/5/2019
DEMC3055	Rohde & Schwarz	3005	Cables	3055	1/8/2018	1/8/2019
DEMC3085	Rohde & Schwarz	FSW43	Spectrum Analyzer	103997	6/9/2017	6/9/2018

NCR = No Calibration Required
DMAS MT-25 RF absorber material was used on the floor for all final measurements above 1 GHz.
Asset DEMC3002: Firmware Version: ESU40 is 4.73 SP4
Asset DEMC3012: Software Version: EMC32-B is 9.15
Asset DEMC3085: Instrument Firmware 2.90 SP1

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Manufacturer	Equipment Type	Model Number	Serial Number
The EUT operates standalone therefore no support equipment was utilized.				

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

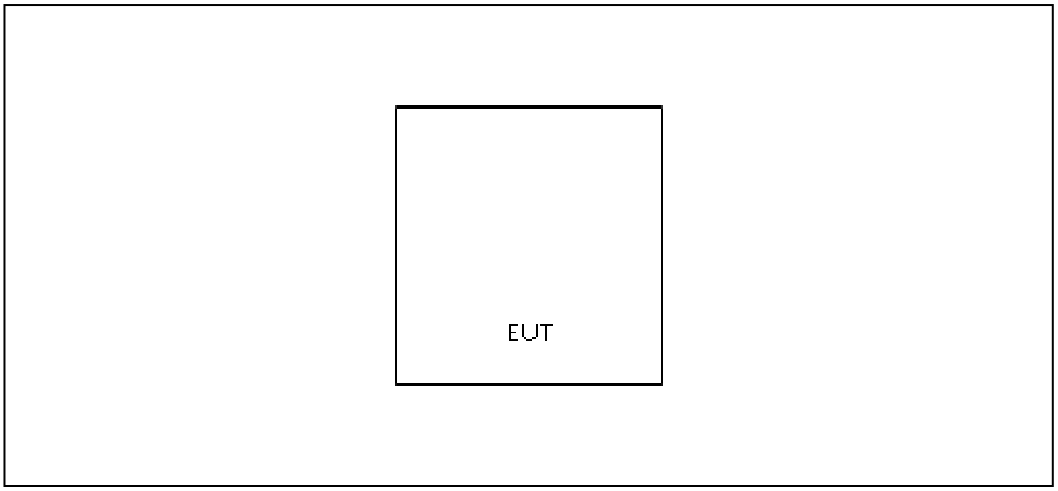

Figure 6-1: EUT Test Setup

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: CFR 47 Part 15.203

The antenna is a loop antenna that is implemented as a trace on the PCB, thus satisfying Part 15.203 requirements.

7.2 AC Power Line Conducted Emissions – FCC: CFR 47 Part 15.207/ISED CANADA: RSS-GEN 8.8

7.2.1 Measurement Procedure

The EUT is battery operated therefore power line conducted emissions is not applicable.

7.3 Periodic Operation – FCC: CFR 47 15.231(a) / ISED CANADA: RSS-210 A1.1 (a)(b)

7.3.1 Test Methodology

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

A transmitter activated automatically shall cease transmission within 5 seconds after activation.

The transmitter was activated manually and was evaluated using a spectrum analyzer at zero span.

7.3.2 Test Results

The transmitter ceased operation after the next whole packet was sent after being manually activated and deactivated. The results are shown in Figure 7.3.2-1 and 7.3.2-2.

Performed by: Jean Tezil

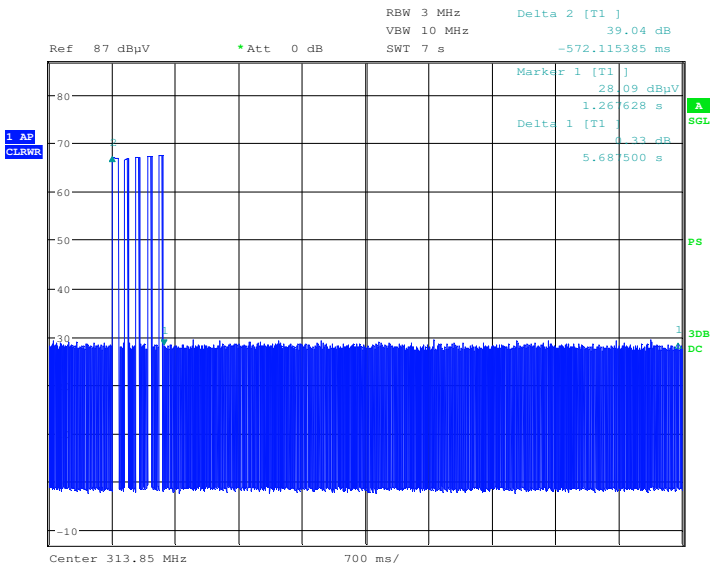

Figure 7.3.2-1: TX Hold Time – 313.85MHz

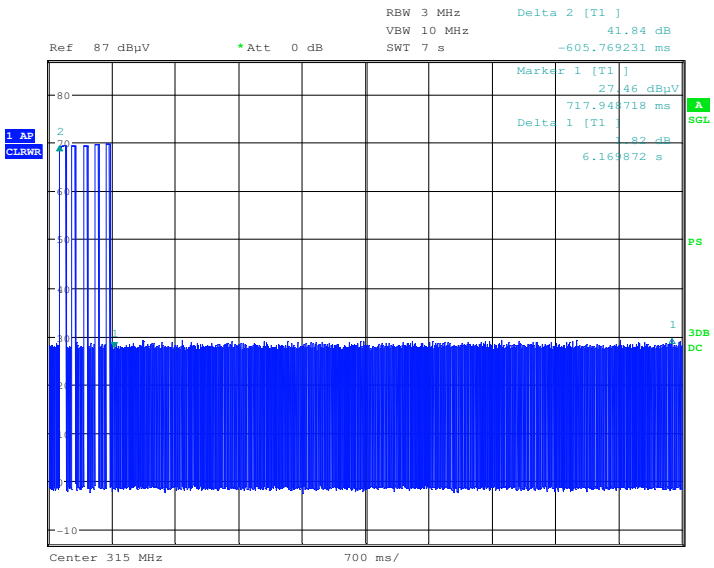

Figure 7.3.2-2: TX Hold Time – 315 MHz

7.4 Occupied Bandwidth – FCC: CFR 47 15.231(c) / ISED CANADA: RSS-210 A1.3

7.4.1 Test Methodology

The span of the spectrum analyzer display was set between two times and five times the occupied bandwidth (OBW) of the emission. The RBW of the spectrum analyzer was set to approximately 1 % to 5 % of the OBW. The trace was set to max hold with a peak detector active. The Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set to 1% to 5% of the occupied bandwidth. The video bandwidth was set to 3 times the resolution bandwidth. A peak detector was used.

7.4.2 Test Results

0.25% of the 313.85 MHz center frequency is equivalent to 784.6 kHz, and 0.25% of the 315 MHz center frequency is equivalent to 787.5 kHz. Therefore the 20 dB and 99% bandwidths of the emissions are less than 0.25% of the center frequencies. The results are shown in Table 7.4.2-1 and the corresponding figures.

Performed by: Jean Tezil

Table 7.4.2-1: 20dB / 99% Bandwidth

Modulation	Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
Mode 1	313.85	96.63	93.91
Mode 2	315	99.04	98.40

Performed by: Jean Tezil

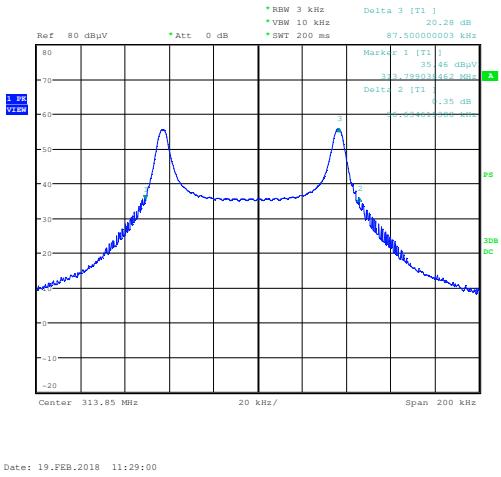

Figure 7.4.2-1: 20 dB Bandwidth – 313.85 MHz

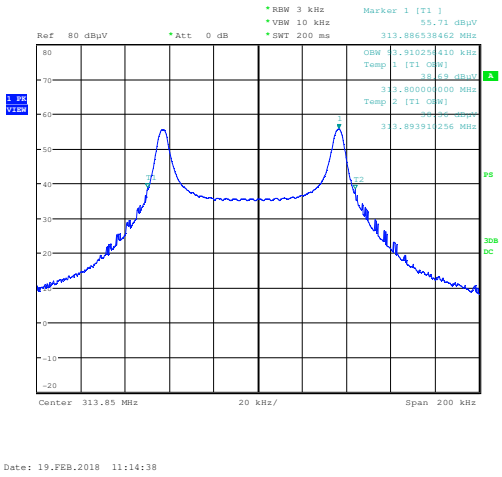

Figure 7.4.2-2: 99% Occupied Bandwidth – 313.85 MHz

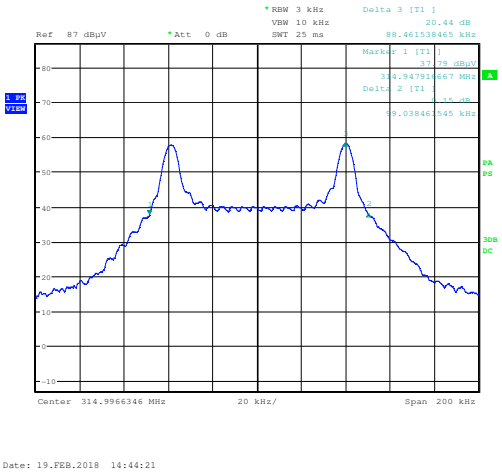

Figure 7.4.2-3: 20 dB Bandwidth – 315 MHz

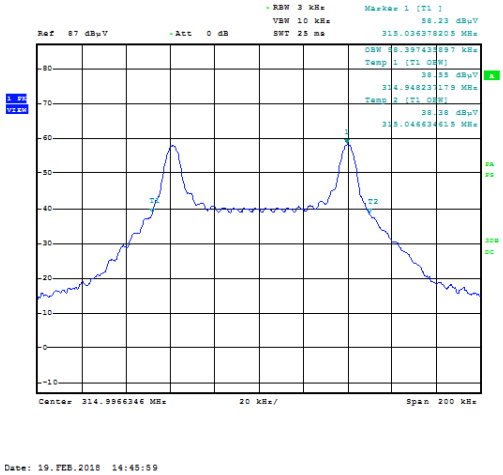

Figure 7.4.2-4: 99% Occupied Bandwidth – 315 MHz

7.5 Radiated Emissions – FCC: CFR 47 15.231(b) / ISED CANADA: RSS-210 A1.2

7.5.1 Test Methodology

Radiated emissions measurements were made over the frequency range of 9 kHz or the lowest frequency generated to 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies between 9 kHz and 150 kHz, measurements were made using a resolution bandwidth (RBW) of 300 Hz and a video bandwidth of 1 kHz. For frequencies between 150 kHz and 30 MHz, measurements were made using a resolution bandwidth (RBW) of 150 kHz and a video bandwidth of 30 kHz. For frequencies between 30 MHz and 1000 MHz, measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz. For frequencies above 1000MHz, measurements were made with RBW of 1 MHz and a VBW of 3 MHz.

Further, compliance with the provisions of 15.205 was demonstrated using the measurement instrumentation specified in that section where applicable.

The EUT utilized pulsed modulation. Therefore, the peak measurements where corrected by the duty cycle for comparison to the average limits.

7.5.2 Duty Cycle Correction

Duty Cycle calculation:

For the 313.85 MHz mode 1, the duty cycle calculation is based on results shown in Figure 7.5.2-1
Pulse = 318.91 ms >100ms
Duty cycle = 100%
Therefore, no duty cycle correction factor was used for the 313.85 MHz mode 1.

For the 315 MHz mode 2, the duty cycle calculation is based on results shown in Figure 7.5.2-2
Pulse = 45.58 ms
Period = 100 ms
Duty cycle = (Pulse*100)/Period = 45.58%

The worst case duty cycle was determined to be 45.58%. The duty cycle correction factor is determined using the formula: 20log (45.58/100) = -6.82 dB.

Performed by: Jean Tezil

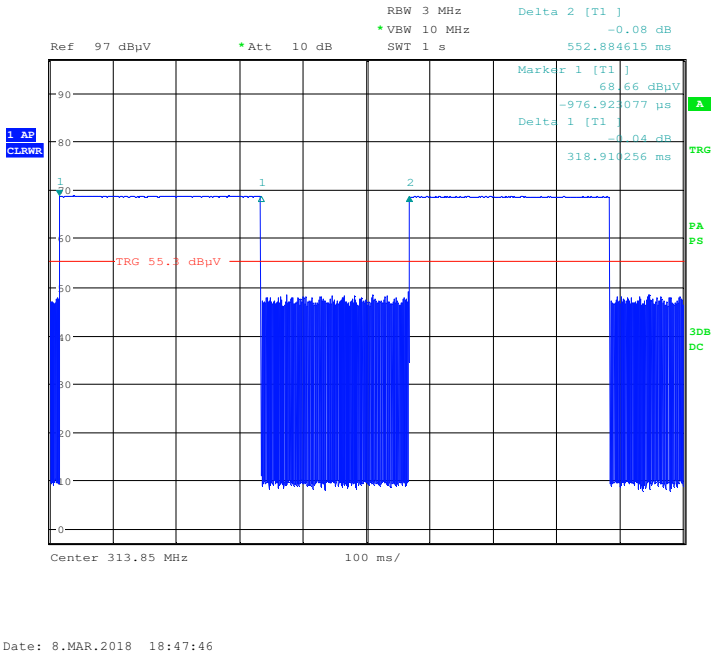

Figure 7.5.2-1: Duty Cycle –Pulse Width – 313.85 MHz

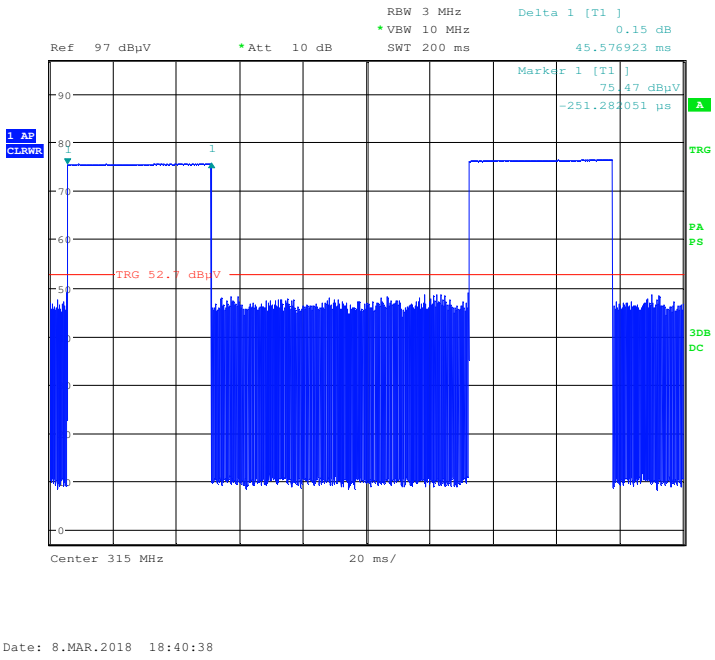

Figure 7.5.2-2: Duty Cycle –Pulse Width – 315 MHz

7.5.3 Test Results

X, Y and Z positions were pre-scanned and X position was determined to be the worst case. The final measurements are reported in Table 7.5.3-1.

Performed by: Jean Tezil

Table 7.5.3-1: Radiated Emissions – 313.85 MHz (Mode 1)

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	pk	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Emission										
313.85	56.90	56.90	H	16.51	73.41	73.4	95.6	75.6	22.2	2.1
313.85	36.80	36.8	V	16.51	53.31	53.3	95.6	75.6	42.3	22.2
Spurious Emissions										
627.7	11.40	11.40	V	20.98	32.38	32.38	75.6	55.6	43.2	23.2
1255.4	43.90	43.90	H	-7.27	36.63	36.63	75.6	55.6	39.0	18.9
1255.4	41.30	41.30	V	-7.27	34.03	34.03	75.6	55.6	41.6	21.5
1569.25	46.20	46.20	H	-6.85	39.35	39.35	74.0	54.0	34.7	14.7
1569.25	42.10	42.10	V	-6.85	35.25	35.25	74.0	54.0	38.8	18.8
1883.1	41.70	41.70	H	-5.34	36.36	36.36	75.6	55.6	39.2	19.2
1883.1	42.10	42.10	V	-5.34	36.76	36.76	75.6	55.6	38.8	18.8
2196.95	46.70	46.70	H	-4.32	42.38	42.38	75.6	55.6	33.2	13.2
2196.95	44.40	44.40	V	-4.32	40.08	40.08	75.6	55.6	35.5	15.5
2510.8	42.70	42.70	H	-3.59	39.11	39.11	75.6	55.6	36.5	16.4
2510.8	42.60	42.60	V	-3.59	39.01	39.01	75.6	55.6	36.6	16.5
2824.65	44.70	44.70	H	-2.65	42.05	42.05	74.0	54.0	31.9	11.9
2824.65	42.90	42.90	V	-2.65	40.25	40.25	74.0	54.0	33.7	13.7
3138.5	45.60	45.60	H	-1.58	44.02	44.02	75.6	55.6	31.6	11.5
3138.5	44.70	44.70	V	-1.58	43.12	43.12	75.6	55.6	32.5	12.4

Table 7.5.3-2: Radiated Emissions – 315 MHz (Mode 2)

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	pk	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Emission										
315.00	64.90	64.90	H	16.30	81.20	74.4	95.6	75.6	14.4	1.2
315.00	43.70	43.7	V	16.30	60.00	53.2	95.6	75.6	35.6	22.4
Spurious Emissions										
630	24.40	24.40	H	21.00	45.40	38.58	75.6	55.6	30.2	17.0
1260	43.80	43.80	H	-7.27	36.53	29.71	75.6	55.6	39.1	25.9
1260	41.70	41.70	V	-7.27	34.43	27.61	75.6	55.6	41.2	28.0
1575	52.80	52.80	H	-6.83	45.97	39.15	74.0	54.0	28.0	14.9
1575	41.60	41.60	V	-6.83	34.77	27.95	74.0	54.0	39.2	26.1
1890	43.40	43.40	H	-5.31	38.09	31.27	75.6	55.6	37.5	24.4
1890	39.70	39.70	V	-5.31	34.39	27.57	75.6	55.6	41.2	28.1
2205	41.80	41.80	H	-4.30	37.50	30.67	74.0	54.0	36.5	23.3
2205	40.70	40.70	V	-4.30	36.40	29.57	74.0	54.0	37.6	24.4
2520	43.20	43.20	H	-3.56	39.64	32.81	75.6	55.6	36.0	22.8
2520	41.80	41.80	V	-3.56	38.24	31.41	75.6	55.6	37.4	24.2
2835	45.90	45.90	H	-2.61	43.29	36.46	74.0	54.0	30.7	17.5
2835	45.40	45.40	V	-2.61	42.79	35.96	74.0	54.0	31.2	18.0
3150	51.40	51.40	H	-1.54	49.86	43.04	75.6	55.6	25.7	12.6
3150	48.80	48.80	V	-1.54	47.26	40.44	75.6	55.6	28.3	15.2

7.5.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation:

Table 7.5.3-1: 313.85 MHz

PEAK:
Corrected Level: 56.9 + 16.51 = 73.41dBuV
Margin: 95.6dBuV – 73.41dBuV = 22.19dB

AVERAGE:
Corrected Level: 56.9 + 16.51 = 73.41dBuV
Margin: 75.6dBuV – 73.41dBuV = 2.19dB

Table 7.5.3-2: 315 MHz

PEAK:
Corrected Level: 64.9 + 16.3 = 81.2dBuV
Margin: 95.6dBuV – 81.2dBuV = 14.4dB

AVERAGE:
Corrected Level: 64.9 + 16.3 -6.82 = 74.38dBuV
Margin: 75.6dBuV – 74.38dBuV = 1.22dB

8 MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

Parameter	U_{lab}
Occupied Channel Bandwidth	**± 0.004%**
RF Conducted Output Power	**± 0.689 dB**
Power Spectral Density	**±0.5 dB**
Antenna Port Conducted Emissions	**± 2.717 dB**
Radiated Emissions	**± 5.877 dB**
Temperature	**± 0.860 °C**
Radio Frequency	**±2.832 x 10-8**
AC Power Line Conducted Emissions	**±2.85**

9 CONCLUSION

In the opinion of TÜV SÜD America, Inc. the MTHKL-G000 manufactured by iKeyless, LLC meets the requirements of FCC Part 15 subpart C and Innovation, Science, and Economic Development Canada's Radio Standards Specification RSS-210.

END REPORT